THE ECOLOGY OF HONEY CREEK, OKLAHOMA: SPATIAL AND TEMPORAL DISTRIBUTIONS OF THE MACROINVERTEBRATES.

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The spatial and seasonal distributions of 77 macroinvertebrate taxa from Honey Creek are presented. Using the simple matching coefficient, phenetic analysis revealed considerable qualitative differences among the riffle, neustic, spring, and pool fauna. Riffle forms were spatially segregated based on both substrate type and longitudinal position. An additional 104 taxa were collected by light trap, dip net, aerial net, drift net, seine, and killing tube.

Although the lotic macroinvertebrates of Oklahoma have received some attention (1-10) the fauna of the limestone streams of the Arbuckle Mountains remain poorly characterized. Hornuff (1) listed 22 taxa from Honey Creek, and recently Reisen (11) added several temporary rock pool forms. McKinley, et al. (6) provided a list of 50 taxa for nearby Travertine Creek; however, collections were made only during the summer and many taxa were not specifically identified.

The purpose of this study was to describe the spatial and temporal distributions of the macroinvertrates of a typical Arbuckle rheocrene. Honey Creek, Murray County, Oklahoma was especially suited because of its moderate size, continuous flow, lack of pollution, and interesting physiography which included several waterfalls and a band of travertine substratum.

MATERIALS AND METHODS

Honey Creek is an unpolluted, limestone stream approximately 25 km in length with the upper 12 km intermittent (1, 10, 12). Land-use includes pasture upstream from Turner Falls Park and downstream from Highway I-35, recreational areas within the park, and sporadic housing between the park and Highway I-35. Honey Creek was subjectively partitioned into the following four habitat groups:

1. Springs: Most of the water in Honey Creek comes from two springs which supported dense growths of *Nasturtium*. On 1 April 73, the discharge of Spring 1 was 0.137 m^3/sec and that of Spring 2 was 0.128 m^3/sec.

2. Pools: The substratum of the pools was mostly travertine covered with silt or sand and gravel in those areas upstream and downstream from the area of travertine deposition. Most pools supported dense stands of *Myriophyllum* during the summer months, but were swept clean by autumnal spates (12).

3. Neustic: Specimens were collected only from water surfaces and generally showed a predilection for the less turbulent areas.

4. Riffles:

Area 1: Spring 1 (source) to Spring 2; distance from source = 2 km; altitude = 367 to 342 m; substrate = cobble and gravel.

Area 2: Spring 2 to Turner Falls; distance = 4½ km; altitude = 342 to 317 m; substrate = travertine.

Area 3: Turner Falls to Cedar Vale Pool; distance = 7½ km; altitude = 317 to 273 m; substrate = travertine.

Area 4: Cedar Vale Pool to Highway I-35; distance = 9½ km; altitude = 273 to 260 m; substrate = cobble.

Area 5: Highway I-35 to Washita River; distance = 12 km; altitude = 260 to 235 m; substrate = pebbles to silt and sand near the Washita.

In springs and riffles, specimens were collected with a 1 m insect seine using the kick method described by Hynes (13), while pool and neustic forms were collected with a dip net and a seine. Once during

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each of the seasons from December, 1972, through October, 1973, several samples were taken at representative sites within each of the habitat groups throughout the length of Honey Creek. Pool and neustic habitats were fairly similar throughout and collections were pooled longitudinally for both groups. Since the collection methods were not comparable or quantitative, only presence or absence was recorded. Phenetic analyses using the simple matching coefficient (14) were conducted to compare habitat groups and to delineate faunistic assemblages with similar distributions. Drift collections were made monthly from June, 1972, through August, 1973, above Turner Falls using the methods presented previously (10, 15). During the warmer months, flying insects were collected using a New Jersey light trap, an aerial net, and a killing tube. Representative taxa have been deposited in the author's collection or with the specialists listed in the acknowledgements.

RESULTS AND DISCUSSION

The 180 taxa collected during this survey (Tables 1 and 2) included many forms not previously listed for Honey Creek (1) or nearby Travertine Creek (6). *Ameletus* sp. and *Psychomia* sp. were not collected during the present survey, but were listed by Hornuff (1) as being common in the riffles and pools, respectively. The fauna of Travertine Creek appeared to differ somewhat as 13 of the 50 taxa listed (6) were not collected in Honey Creek. Intermittent Otter Creek (5) and polluted Skeleton Creek (3) exhibited even more marked differences.

Since Honey Creek remained relatively warm (mean annual water temperature = 19.2 C, range = 6 to 29), most of the fauna could be collected throughout the year. However, some forms, e.g. *Simulium vittatum*, *Allocapnia*, and *Brachyptera*, were abundant only during the winter, while others, e.g. many Ephemeroptera, Trichoptera, and Coleoptera, were typically summer forms, and a few taxa, e.g. *Perlesta placida* and the Hydroptilidae, were collected primarily in the spring and fall.

The results of the phenetic analyses of habitat groups and their faunistic components are presented in Figures 1 and 2, respectively. For these analyses the four

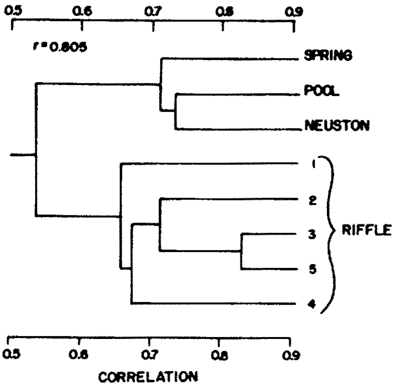

FIGURE 1. The phenetic separation of habitat groups.

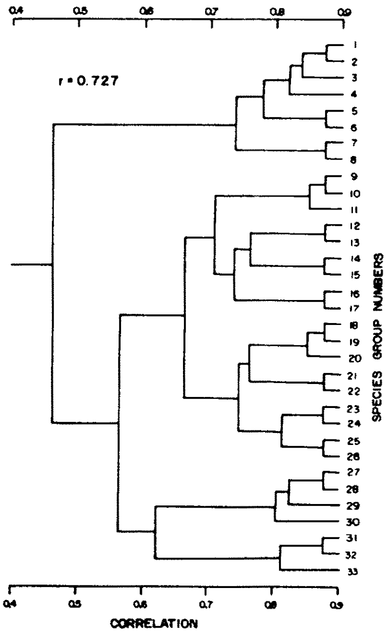

FIGURE 2. The phenetic separation of the taxa based on distribution. Species in Groups 1 to 33 are listed in Table 1.

Table 1. *Spatial and temporal distribution of the macroinvertebrates of Honey Creek. a = 15 Dec 72; b = 1 Apr 73; c = 17 Jul 73; d = 28 Oct 73.*

Taxon	Spring	Riffle 1	Riffle 2	Riffle 3	Riffle 4	Riffle 5	Pool	Neuston	Phenetic Group No.
Diptera									
Simulium sp. a.		ad	abd	abcd		ad			1
Simulium virgatum Coquillett		ad	abd	abcd		ad			1
Simulium vittatum Zetterstedt		ab	a		a	a			5
Simulium venustum Say			bd	d					9
Simulium trivittatum Malloch		d	abcd	abd	ad	cd			5
Chironomidae[a]	cd	abcd	abcd	abcd	abcd	abcd	bcd		7
Atherix variegata Walker		d	bcd						27
Euparyphus cinctus (O. S.)		c	abcd						27
Tipula spp.	bd	d	bcd						28
Tabanus dorsifer Walker	bd	bd			d	c			31
Elinia spp.		b							18
Trichoptera									
Oectus inconspicua Walker					c				21
Hydropsyche sp. a.		ab	abc	acd	ac	a			2
Hydropsyche bifida Banks		bd	cd	d	bd	c			2
Hydropsyche simulans Ross					c				21
Smicridea sp.		b			b				22
Cheumatopsyche (prob. *analis*)		acd	acd	c	acd	acd			2
Helopsyche borealis (Hagen)	ac	d			cd				32
Chimarra obscura (Walker)					abcd	abcd			19
Chimarra feria Ross		d	c		c				6
Ochrotrichia tarsalis (Hagen)	b	b	d						28
Ochrotrichia spinosus (Ross)	b	b	b						28
Mayatrichia nr *ayama* Mosely			b						10
Ephemeroptera									
Centroptilium spp.		acd	abcd	cd	acd	cd	cd		8
Baetodes sp.			abcd	acd	cd	d			3
Pseudocleon spp.			ab	ab	c	abc			3
Baetis bicaudatus Dodds			b						10
Dactylobaetis mexicanus Edmunds and Traver							c		12
Caenis sp.							c		12
Tricorythodes spp.		c	c	c	cd	bcd	cd		8
Stenonema spp.		bd	c		b	ab			5
Hexagenia spp.			c						10
Isonychia sp.					bc	c			23
Plecoptera									
Perlesta placida (Hagen)		b	b	bd	b	b			2
Allocapnia sp.		a			a	a			14
Brachyptera sp.						a			25
Megaloptera									
Corydalis cornutus (Linn.)		ab			bcd	acd			24
Sialis sp.					c				21
Lepidoptera									
Cataclysta sp.			d	cd	acd	c			3
Coleoptera									
Lutrochus luteus (LeConte)		ac	acd	abcd	cd	c			2
Microcylloepus pusillius LeConte		a	cd	d	ac	ac			2
Dubiraphia vittata (Mekh.)							d		12
Stenelmis convexula Sanderson		c			c				22
Helichus suturalis LeConte	c								14
Hydrovatus spp.	d	d	a		c				29
Hydaticus sp.	bc	ab	c				b		30
Agabus sp.	c	d	c				c		30
Berosus striatus (Say)		c							18
Haliplus sp.			c				c		13
Pelonomus obscuris LeConte		b							18
Dactylosternum sp.	c								14
Bidessus affinis Say		ac				b			26

Helochares sp.		b				a			26
Tropisternus ellipticus (LeConte)	d								18
Dineutes ciliatus (Forsberg)								bcd	16
Odonata									
Heterina americanum (Fabricus)					d	cd			23
Enallagma exsulans (Hagen)			c						10
Argia spp.	d	d			d	cd	cd		33
Dythemis velox Hagen					cd				21
Dromogomphus spinosus (Selys)							d		12
Anomalagrion sp.					c				21
Calopteryx maculata (Beauvois)					cd				21
Hemiptera									
Sigara modesta (Abbott)							d		12
Gerris remigis Say								bcd	16
Rhagovelia armata (Brum.)								c	16
Rhagovelia choreutes Hussey								abcd	16
Microvelia americana Uhler								c	16
Plea striola Fieber							c		17
Amphipoda									
Hyalella azteca Saussure	abcd						abcd		15
Allocrangonyx pellucidus (Mackin)	ad								24
Isopoda									
Asellus tridentatus (Hung.)	abcd	c	b	c	bc	ad			4
Decapoda									
Orconectes nais (Faxon)							abcd		12
Acarina									
Sperchonopsis verrucosa (Frotz)			cd		cd				11
Hydrachna sp.							c		12
Mollusca									
Physa sp.	abcd	c	cd	ab	cd	abcd	abcd		7
Heliosoma sp.		abcd	a	d	d	a			2
Pisidium sp.		cd		d					20
Platyhelminthes									
Dugesia sp.	acd	acd	ac		acd				29

[a] early instars not separable.

seasonal samples were pooled. The habitat separations were as expected with the riffle benthos being markedly different from the other habitat types. The spring fauna included the hypogean forms as well as other taxa such as *Hyalella azteca* which was collected amongst the vegetation. The pool forms were usually associated with the dense *Myriophyllum* beds which choked the pools during late summer. The neuston consisted solely of the Gerridae, Veliidae and Gyrinidae. Within the riffle habitat group, Areas 1 and 4 with cobble substrata were segregated on the basis of substrate type rather than longitudinal position. Turner Falls seemed to function as a biological barrier for Area 2, above Turner Falls with travertine substrata, was considerably different from Areas 3 and 5, below Turner Falls having travertine and small pebble and sand substrata, respectively (Fig. 1).

The invertebrates were separated into 33 groups (Fig. 2) with the taxa having identical spatial distributions awarded the same phenetic group number (Table 1). Groups 1 to 8 were the first to be segregated and consisted of the species ubiquitously distributed throughout the five riffle areas; Groups 27 to 30 were restricted to the upper reaches of Honey Creek and were occasionally collected from the springs; Groups 31 to 33 were composed of an unassociated assemblage of taxa with miscellaneous distributions; Groups 9 to 11 were all restricted to Area 2 riffles with travertine substratum; Groups 12 and 13 were found mostly in pools; Groups 14 and 15 showed some predilection for the springs; Group 16 was comprised solely of neuston; Group 17, *Plea striola*, was restricted to the *Myriophyllum* beds; Groups 18 to 26 consisted of an assortment of riffle benthos sub-

TABLE 2. *Additional aquatic or semi-aquatic fauna collected at Honey Creek. Method of collection: LT = N.J. Light trap, DN = drift net, AN = aerial net, B = biting, DIN = dip net, S = seine, Life stage: A = Adult, L = larvae, P = pupae, N = nymph.*

Taxon	Method of Collection	Life Stage
Diptera		
Psorophora confinnis (Lynch Arribalyaga)	LT	A
Anopheles pseudopunctipennis (Theobald)	LT	A
Culex pipiens quinquefasciatus Say	LT, B	A
Tipula triplex Walker	LT, AN	A
Tipula tricolor Fabr.	LT, AN	A
Limonia canadensis (Westwood)	LT	A
Gonomyia gaegei Rogers	LT	A
Gonomyia alexanderi (Johnson)	LT	A
Symplecta cana (Walker)	LT	A
Conchapelopia sp.	DiN	P
Paramerina testa Roback	LT	A
Ablabesmyia mallochi (Walley)	LT, DiN, S	A, L
Ablabesmyia ramphe Sublette	LT, S	A, L
Labrundinia becki Roback	LT	A
Pentaneura inconspicua (Malloch)	LT	A
Procladius sublettei Roback	LT	A
Larsia berneri Beck & Beck	LT	A
Trissocladius sp.	S	L
Eukiefferiella sp.	S, DiN	L
Cricotopus spp.	S, DiN	L
Cricotopus sp. A.	LT	A
Paracladius sp.	S, DiN	L
Eurothocladius sp. A.	LT, DiN, S	A, L
Dicrotendipes fumidus (Joh.)	LT	A
Dicrotendipes modestus (Say)	LT	A
Dicrotendipes botaurus (Townes)	LT	A
Nilothauma babiyi (Rempel)	LT	A
Nilothauma sp. A.	LT	A
Polypedilum sp. A	LT	A
Polypedium digitifer (Townes)	LT	A
Polypedium griseopuctatum	LT	A
Polypedium sp.	DiN	L
Cryptochironomus ponderosus (Sublette)	LT	A
Cryptochironomus sp. A.	LT	A
Cryptocladopelma cnllator Townes	LT	A
Paratendipes duplicatus (Joh.)	LT	A
Microtendipes sp.	S	L
Pseudochironomus fulviventris (Joh.)	LT	A
Pseudochironomus richardsoni (Malloch)	LT	A
Pseudochironomus julia (Curran)	LT	A
Pseudochironomus sp.	S, DiN, DN	L
Endochironomus subtendens (Townes)	LT	A
Stictochironomus sp.	DiN	L
Paralauterborniella nigrohalteralis (Malloch)	LT	A
Paralauterborniella subcinata (Townes)	LT	A
Tanytarsus sp. A.	LT	A
Tanytarsus sp. B	LT	A
Tanytarsus confusus (Malloch)	LT	A
Paratanytarsus sp. A.	LT	A
Paratanytarsus sp. B.	LT	A
Tabanus sulcifrons Macquart	B	A
Tabanus abactor Philip	B	A
Chrysops sequax Williston	B	A
Bezzia sp.	DN	L
Wiedemannia sp.	DN, DiN	L
Clinocera sp.	DN, AN	A
Hilara sp.	DN, AN	A
Scatella sp.	DiN	P
Stratiomys spp.	DN, DiN	L
Ephemeroptera		
Hexagenia limbata venusta Eaton	LT	A
Hexagenia rigida McDunnough	LT	A

Hexagenia bilineata (Say)	LT	A
Stenonema sp. A.	LT, AN	A
Stenonema sp. B	LT	A
Stenonema interpunctatum canadense Walker	LT	A
Stenonema femoratum tripunctatum Banks	LT	A
Caenis nr *simulans* McDunnough	LT	A
Pseudocleon nr *punctiventris* McDunnough	LT	A
Leptophlebia sp.	LT	A
Paraleptophlebia sp.	DN	N
Cleon sp.	DN	N
Isonychia nr *pacoleta* Traver	LT	A
Siphonurus sp.	DN	N
Odonata		
Libellula luctrosa Burmeister	DN, AN	N, A
Ereptogomphus designatus Hagen	AN	A
Argia moesta (Hagen)	AN	A
Argia fummipennis violacea (Hagen)	AN	A
Argia immunda (Hagen)	AN	A
Argia nahuana Calvert	AN	A
Argia sp.	AN	A
Neballenia sp.	DN	N
Trichoptera		
Cernotinia calcea Ross	LT	A
Cernotinia spicata Ross	LT	A
Hydroptila sp.	AN, LT	A
Cheumatopsyche analis Banks	LT	A
Coleoptera		
Hexocylloepus ferrugineus Horn	DN	A
Peltodytes sp.	DN	A
Gyretes sp.	DN, DiN	A
Helophorus sp.	DN	A
Hydrochara sp.	DN	A
Cymbiodyta sp.	DN	A
Donacia sp.	DN	L
Hemiptera		
Pentacora signoreti (Guerin)	AN, DN	A
Macrocanthus quadrimaculata (Champion)	DN	A
Rheumobates truliger Bergroth	DN	A, N
Rheumobates rileyii Blatchley	DN	A, N
Trepobates subnitidus Esaki	DN	A, N
Mesovelia mulsanti White	DN	A
Lethocerus sp.	DN	N
Collembolla		
Hydroisotoma schaferi (Kraus.)	DN	A
Oligochaeta		
Eiseniella tetraedra (Savigny)	DN	A
Hirudinea		
Glossiphonia sp.	DN	A
Acarina		
Limnesia sp.	DN	L

divided by their longitudinal distributions with the exception of Group 24, *Allocrangonyx pellucidus*, which was collected only from Spring 2. The phenograms seemed to fit the data well as the phenetic correlations were 0.805 and 0.727 for Figures 1 and 2, respectively.

The additional taxa presented in Table 2 include only those taxa not presented in Table 1, although many of the Table 1 taxa were also collected by these methods. The Culicidae and *Tabanus* spp. were only collected as adults. The Saldidae and *Gelastocoris oculatus* (Fabr.) collected by drift net were considered to be semi-aquatic preferring the shoreline habitat.

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